09/555236
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

REQUEST FOR FILING NATIONAL PHASE OF
PCT APPLICATION UNDER 35 U.S.C. 371 AND 37 CFR 1.494 OR 1.495

To: Asst. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

(Our Deposit Account No. 03-3975

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

Atty Dkt: **PM** 270689
/2971095US/LT/HER
M# /Client Ref.

From: Pillsbury Madison & Sutro LLP, IP Group:

Date: May 25, 2000

This is a **REQUEST** for **FILING** a PCT/USA National Phase Application based on:

1. International Application	2. International Filing Date	3. Earliest Priority Date Claimed
PCT/FI98/00921 ⇧ country code	24 November 1998 Day MONTH Year	1 December 1997 Day MONTH Year (use item 2 if no earlier priority)

4. Measured from the earliest priority date in item 3, this PCT/USA National Phase Application Request is being filed within:

(a) ☐ 20 months from above item 3 date (b) ☒ 30 months from above item 3 date,

(c) Therefore, the due date (unextendable) is June 1, 2000

5. Title of Invention METHOD AND EQUIPMENT FOR IDENTIFYING A LOGICAL CHANNEL

6. Inventor(s) PUHAKAINEN et al.

Applicant herewith submits the following under 35 U.S.C. 371 to effect filing:

7. ☒ Please immediately start national examination procedures (35 U.S.C. 371 (f)).

8. ☐ **A copy of the International Application** as filed (35 U.S.C. 371(c)(2)) is transmitted herewith (file if in English but, if in foreign language, file only if not transmitted to PTO by the International Bureau) including:

a. ☐ Request;
b. ☐ Abstract;
c. _____ pgs. Spec. and Claims;
d. _____ sheet(s) Drawing which are ☐ informal ☐ formal of size ☐ A4 ☐ 11"

9. ☒ **A copy of the International Application has been transmitted by the International Bureau.**

10. **A translation of the International Application** into English (35 U.S.C. 371(c)(2))

a. ☒ is transmitted herewith including: (1) ☐ Request; (2) ☐ Abstract;
(3) 15 pgs. Spec. and Claims;
(4) 4 sheet(s) Drawing which are:
☐ informal ☒ formal of size ☒ A4 ☐ 11"

b. ☐ is not required, as the application was filed in English.

c. ☐ is not herewith, but will be filed when required by the forthcoming PTO Missing Requirements Notice per Rule 494(c) if box 4(a) is X'd or Rule 495(c) if box 4(b) is X'd.

d. ☐ Translation verification attached (not required now).

RE: USA National Filing of PCT/FI98/00921

11. ☒ **PLEASE AMEND** the specification before its first line by inserting as a separate paragraph:
a. ☒ --This application is the national phase of international application PCT/FI98/00921 filed November 24, 1998 which designated the U.S.--
b. ☐ --This application also claims the benefit of U.S. Provisional Application No. 60/_____, filed _____.--

12. ☒ Amendments to the claims of the International Application **under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e., before 18th month from first priority date above in item 3, are transmitted herewith (file only if in English) including:**

13. ☒ PCT Article 19 claim amendments (if any) have been transmitted by the International Bureau

14. ☒ Translation of the amendments to the claims **under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e., of claim amendments** made before 18th month, **is attached (required by 20th month from the date in item 3 if box 4(a) above is X'd, or 30th month if box 4(b) is X'd, or else amendments will be considered canceled).**

15. **A declaration of the inventor** (35 U.S.C. 371(c)(4))
a. ☒ is submitted herewith ☒ Original ☐ Facsimile/Copy
b. ☐ is not herewith, but will be filed when required by the forthcoming PTO Missing Requirements Notice per Rule 494(c) if box 4(a) is X'd or Rule 495(c) if box 4(b) is X'd.

16. **An International Search Report (ISR):**
a. Was prepared by ☒ European Patent Office ☐ Japanese Patent Office ☐ Other
b. ☒ has been transmitted by the international Bureau to PTO.
c. ☒ copy herewith (2 pg(s).) ☒ plus Annex of family members (2 pg(s).).

17. **International Preliminary Examination Report** (IPER):
a. ☒ has been transmitted (if this letter is filed after 28 months from date in item 3) in English by the International Bureau with Annexes (if any) in original language.
b. ☐ copy herewith in English.
c.1 ☐ IPER Annex(es) in original language ("Annexes" are amendments made to claims/spec/drawings during Examination) including attached amended:
c.2 ☒ Specification/claim pages #_____ claims #1-16
Dwg Sheets #
d. ☒ Translation of Annex(es) to IPER **(required by 30th month due date, or else annexed amendments will be considered canceled).**

18. **Information Disclosure Statement** including:
a. ☒ Attached Form PTO-1449 listing documents
b. ☒ Attached copies of documents listed on Form PTO-1449
c. ☒ A concise explanation of relevance of ISR references is given in the ISR.

19. ☒ **Assignment** document and Cover Sheet for recording are attached. Please mail the recorded assignment document back to the person whose signature, name and address appear at the end of this letter.

20. ☐ Copy of Power to IA agent.

21. ☐ **Drawings** (complete only if 8d or 10a(4) not completed): ___ sheet(s) per set: ☐ 1 set informal; ☐ Formal of size ☐ A4 ☐ 11"

22. ☐ _____ (No.) **Verified Statement(s)** establishing "small entity" status under Rules 9 & 27

23. **Priority** is hereby claimed under 35 U.S.C. 119/365 based on the priority claim and the certified copy, both filed in the International Application during the international stage based on the filing in (country) FINLAND of:

Application No.	Filing Date	Application No.	Filing Date
(1) 974381	December 1, 1997	(2)	
(3)		(4)	
(5)		(6)	

a. ☒ See Form PCT/IB/304 sent to US/DO with copy of priority documents. If copy has not been received, please proceed promptly to obtain same from the IB.
b. ☐ Copy of Form PCT/IB/304 attached.

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24. Attached: See Preliminary Amendment

25. **Preliminary Amendment:**

25.5 Per Item 17.c2, **cancel original** pages #_____, claims #_____, Drawing Sheets #

26. **Calculation of the U.S. National Fee (35 U.S.C. 371 (c)(1)) and other fees is as follows:**
Based on amended claim(s) per above item(s) ☐ 12, ☐ 14, ☐ 17, ☐ 25, ☐ 25.5 (hilite)

Total Effective Claims	21	minus 20 =	1	x $18/$9	=	$18	966/967
Independent Claims	6	minus 3 =	3	x $78/$39	=	$234	964/965
If any proper (ignore improper) Multiple Dependent claim is present,				add$260/$130		+0	968/969

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(4)): →→ **BASIC FEE REQUIRED, NOW** →→→→

A. If country code letters in item 1 are **not** "US","BR","BB","TT","MX","IL" "NZ", "IN" or "ZA"

See item 16 re:

1.	Search Report was not prepared by EPO or JPO	add$970/$485		960/961
2.	Search Report was prepared by EPO or JPO	add$840/$420	+840	970/971

SKIP B, C, D AND E UNLESS country code letters in item 1 are "US","BR","BB","TT","MX","IL", "NZ", "IN" or "ZA"

→ ☐	B.	If USPTO did not issue both International Search Report (ISR) and (if box 4(b) above is X'd) the International Examination Report (IPER),	add$970/$485	+0	960/961
→ ☐	C.	If USPTO issued ISR but not IPER (or box 4(a) above is X'd),	add$690/$345	+0	958/959
→ ☐	D.	If USPTO issued IPER but IPER Sec. V boxes not all 3 YES,	add$670/$335	+0	956/957
→ ☐	E.	If international preliminary examination fee was paid to USPTO and Rules 492(a)(4) and 496(b) satisfied (IPER Sec. V all 3 boxes YES for all claims),	add $96/$48	+0	962/963

27.		**SUBTOTAL =**	$1092
28.	If Assignment box 19 above is X'd, add Assignment Recording fee of ----$40		+40 (581)
29.	Attached is a check to cover the	**TOTAL FEES**	$1132

Our Deposit Account No. 03-3975
Our Order No. 60258 (C#) 270689 (M#)

CHARGE STATEMENT: The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and which may be required under Rules 16-18 and 492 (missing or insufficient fee only) now or hereafter relative to this application and the resulting Official document under Rule 20, or credit any overpayment, to our Account/Order Nos. shown above for which purpose a duplicate copy of this sheet is attached.
This CHARGE STATEMENT does not authorize charge of the issue fee until/unless an issue fee transmittal form is filed

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NOTE: File in duplicate with 2 postcard receipts (PAT-103) & attachments.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Stage Application of PCT/FI98/00921

PUHAKAINEN et al. Group Art Unit: Not Yet Assigned

Appln. No.: Not Yet Assigned Examiner: Not Yet Assigned

Filed: May 25, 2000

FOR: METHOD AND EQUIPMENT FOR IDENTIFYING A LOGICAL CHANNEL

* * * * *

May 25, 2000

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents
and Trademarks
Washington, DC 20231

Sir:

Before beginning examination, kindly amend the above-identified National Stage application as follows:

IN THE CLAIMS:

Please amend the amended claims from the annexes to the International Preliminary Examination Report as follows:

Claim 4, line 1, delete "or 3".

Claim 8, line 1, delete "or 7".

Claim 9, line 1, delete "any one of claims 5 to 8" and insert --claim 5--.

Claim 10, line 1, delete "any one of claims 5 to 8" and insert --claim 5--.

Claim 14, line 1, delete "any one of claims 11 to 12" and insert --claim 11--.

Claim 15, line 1, delete "any one of claims 11 to 12" and insert --claim 11--.

Claim 16, line 1, delete "any one of claims 11 to 12" and insert --claim 11--.

Please add the following new claims 17-21.

--17. A receiver according to claim 6, characterized in that the receiver is part of a base station of a mobile communications system.

18. A receiver according to claim 6, characterized in that the receiver is part of a subscriber terminal of a mobile communications system.

19. A unit according to claim 12, characterized in that the unit is arranged to interpret, in response to a channel decoding of the latter time slot block succeeding when the channel decoding method relating to stealing is applied, said time slot as a whole to comprise control channel data.

20. A unit according to claim 12, characterized in that the unit is part of a base station of a mobile communication system.

21. A unit according to claim 12, characterized in that the unit is part of a subscriber terminal of a mobile communication system.--

REMARKS

Upon entry of this amendment, there will be no multiple dependent claims in the application.

Respectfully submitted,

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By

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METHOD AND EQUIPMENT FOR IDENTIFYING A LOGICAL CHANNEL

BACKGROUND OF THE INVENTION

The invention relates to mobile communications systems and particularly to a method and equipment for identifying a logical channel in a radio frame part which may comprise information of one or more logical channels, channel decoding of the information being possible by means of channel decoding methods relating to the different logical channels.

In digital radio systems a physical channel provides a link at the interface between a subscriber terminal and a network. A physical channel substantially comprises a frame part of a selected multiple access technique, the frame part being allocated to data transmission between a particular subscriber terminal and the network. A physical channel can therefore comprise for instance one or more TDMA frame time slots arranged at a specific frequency range, or frame parts separated by means of a CDMA frame code.

Physical channels are utilized by means of various multiplexing techniques whereby logical channels are created on a physical link. The term logical channel refers to a logical data transmission bus between two or more parties, the bus being mapped on an interface between a protocol and a radio system. A mobile communications system or a part thereof can therefore comprise different types of logical channels. Logical channels are typically divided into traffic channels (TCH), which comprise different kinds of traffic relaying channels, and control channels (CCH), which comprise e.g. broadcast control channels, common control channels and dedicated control channels. Speech and circuit-switched data are transferred over the radio interface substantially on traffic channels and signalling and packet data on control channels.

As a rule, a logical channel associated with a received signal can be concluded from the used multiplexing technique, but this does not always apply. A number of mobile communications systems allow signalling, for example, to be also transferred on traffic channels when necessary, a burst to be transmitted then preferably comprising information indicating whether transmission of traffic data or signalling is concerned. This procedure will be hereinafter referred to as stealing.

In the TETRA (TErrestrial, Trunked RAdio) digital mobile

communications system a physical channel is substantially comprised of one time slot of a TDMA frame comprising four time slots, the time slot corresponding to one burst transferred over a radio path. A normal uplink or downlink time slot typically comprises two blocks, with a bit map called a training sequence between them. A training sequence is used for indicating features relating to transmission timing and distortion, which are typically important in demodulation, to a receiver.

In the TETRA system two normal 22-bit training sequences differing from one another are defined, the training sequences being used for indicating whether the burst blocks comprise one or two logical channels. The above described stealing from a traffic channel is also indicated by using a training sequence. When a burst comprises a training sequence 1 (TS1), stealing is interpreted not to be in use, and the burst comprises entirely traffic channel data. When a burst comprises a training sequence 2 (TS2), the time slot into which the burst is mapped is interpreted to be either totally or partly stolen for signalling purposes.

In circumstances where reception is subject to fading and noise, it has proved to be most difficult to distinguish training sequences, and thus logical channels relating to a time slot, from one another. If a training sequence TS1 is by mistake interpreted as a training sequence TR2, the receiver concludes that a signalling message is concerned, which causes traffic channel blocks to be lost and decreases data transmission capacity. If a training sequence TS2 is by mistake interpreted as a training sequence TR1, the receiver interprets that traffic channel data is concerned, the transmitted signalling being thereby lost. The possibility that a logical channel can be misinterpreted in this way is most disadvantageous for the operation of the system. Errors in interpretations are particularly problematic in channels in which bit error ratio should be very small to support efficient channel coding.

BRIEF DESCRIPTION OF THE INVENTION

An object of the invention is therefore to provide a method and an equipment implementing the method so as to allow logical channels in received radio frames to be identified with certainty also in demanding operational circumstances.

The objects of the invention are achieved with a method according to any one of independent claims 1, 2 or 3. The invention also relates to a receiver according to any one of independent claims 6, 7, or 8 and to a

channel decoding unit according to any one of independent claims 13, 14 or 15. The preferred embodiments of the invention are disclosed in the dependent claims.

The invention is based on the use of channel decoding for identifying a logical channel relating to the information that a frame part to be examined comprises. The identification can be a primary identification, or a confirming identification taking place after a primary identifier, preferably a bit map, said frame part comprises, has been interpreted. If an identification based on channel decoding contradicts an identification based on the bit map, the receiver can be arranged to indicate the logical channel information on the basis of the channel decoding for instance by changing, when selected criteria are met, the bit map to a bit map conforming to the logical channel identified on the basis of the channel decoding. The selected criteria are determined for each application separately after it has been decided which channels are to be primarily identified with certainty and how much resources are to be used for the identification.

The method and system of the invention considerably improve the capacity of a receiver in a mobile communications system because a significant portion of misinterpretations relating to the logical channel are left out.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention will be described in greater detail in connection with preferred embodiments and with reference to the attached drawings, in which

Figure 1 illustrates a prior art frame structure in the TETRA system;

Figures 2 and 3 are simplified diagrams illustrating uplink and downlink bursts in the TETRA system according to the prior art;

Figure 4 is a simplified diagram illustrating a TDMA frame structure in the TETRA system and the functional parts of a TETRA transmitter and receiver according to the prior art;

Figure 5 is a flow diagram illustrating a basic principle of the invention;

Figure 6 is a flow diagram illustrating a solution of the invention in a case in which a received time slot comprises the information of a logical channel relating to the time slot; and

Figure 7 is a flow diagram illustrating the application of the method

of the invention to the detection of stealing in the TETRA system.

DETAILED DESCRIPTION OF THE INVENTION

In the following the invention will be described as applied to the TETRA system (TErrestrial Trunked RAdio), the invention not being restricted to the system or to the names of the structural parts. The solution of the invention can also be applied to other digital radio systems in which a logical channel relating to a time slot is not always unambiguously apparent from the frame structure used.

Figure 1 shows a frame structure in the TETRA system. In the TETRA system a physical channel is comprised of one TDMA time slot, a TETRA frame comprising a total of four time slots. One time slot comprises 510 bits (255 modulation symbols) and its duration is 14.167 ms. A TETRA superframe, the duration of which is 1.02 s, comprises 18 TETRA frames, the 18th frame of the superframe being reserved as a control frame. A TETRA hyperframe comprises 60 TETRA superframes and its duration is 61.2 s.

A burst is a sequence modulated by carrier data flow and it describes the physical contents of a time slot. In the TETRA system, eight different bursts are determined. In the following we shall examine a Normal Uplink Burst NUB, which a subscriber terminal uses for data transmission towards a base station; and a continuous Normal Downlink Burst NDB, which the base station uses for data transmission towards the subscriber terminal. Said bursts typically comprise a normal training sequence in the middle of the burst, with blocks that may comprise either traffic or control channel data on each side of the training sequence. Figures 2 and 3 are simplified diagrams illustrating uplink and downlink bursts in the TETRA system.

The uplink burst NUB comprises two four-bit tails 21, 25, which are used for equalisation purposes and for reducing filter transient responses at the beginning and end of the bursts. In the middle of the burst there is a normal 22-bit training sequence 23 which indicates whether the burst blocks comprise one or two logical channels, the training sequence also implicitly denoting whether the first burst block or both the blocks comprise signalling data instead of traffic data. Between the tails and the training sequences are left 216-bit data bit blocks 22 and 24.

The downlink burst NDB comprises a plural number of fields, but also this burst substantially comprises a normal training sequence 35 in the middle and, on each side of it blocks 33 and 37 that may, as mentioned,

comprise traffic data or control data. In addition, the burst begins and ends with a third 22-bit training sequence 31 which is divided over the interface between two bursts so that there are 12 bits at the beginning and 10 bits at the end of a burst. The third training sequence 31 is followed by two phase control bits 32 after which comes a 216-bit data bit block 33 and 14 broadcast bits 34. The normal training sequence 35 is located in the middle of the burst and it is correspondingly followed by 16 broadcast bits 36, a 216-bit data bit block 37, phase control bits 38 and a third training sequence 39.

When the circumstances for transmission and reception are good, stealing can be identified on the basis of a training sequence without major problems. Measurements have shown, however, that stealing misinterpreted in demanding transmission and reception circumstances significantly impairs channel bit error ratio.

Figure 4 is a simplified diagram illustrating a TDMA frame structure and the functional parts of a TETRA transmitter 410 and a TETRA receiver 420 in connection with transmission of speech in the TETRA system. Speech is converted in an A/D converter 41 from analog to digital form and packed in an ACELP speech codec 42 for transmission over the radio interface. After speech coding the separate signal packets are secured against data transmission errors in a channel coding unit 43. At channelization (MUX 44) the signals received from different sources are combined for the duration of the data transmission so that they can use a common transmission path. The packed speech is conveyed in consecutive TDMA frames via a specific time slot over the radio interface. At the reception end the packet is opened in a reverse order by means of a multiplexer 45, a channel decoder 46 and a speech decoder 47 and the digitized speech data is converted in a converter 48 into an analog signal which is reproduced as sound. Functional blocks at circuit-switched data traffic channels (TCH/7.2, TCH/4.8, TCH/2.4) of the TETRA system are similarly arranged, except for speech coding and decoding.

In channel coding, redundant data calculated on the basis of source data is added to the source data. In channel decoding a reverse calculation is performed, the redundancy data thus allowing errors caused by the transmission path to be corrected and the success of the channel decoding to be evaluated. In the TETRA system convolution codes are used for error correction and a cyclic redundancy check CRC for the evaluation of the success of channel decoding. The present embodiment is based on that CRC

calculation allows evaluating, with great accuracy, whether a received message has been correctly or incorrectly decoded. For instance, the probability of an STCH CRC not detecting that a message is incorrectly decoded is of the order 0.00001.

Figure 5 is a block diagram illustrating a basic principle of the invention on a general level: the use of channel decoding for identifying a logical channel. At step 505 channel types, the total number of which is N_{max}, are arranged into a predetermined order, preferably according to the likelihood of occurrence. In other words, if incoming bursts are most likely to be traffic data and next likely to represent specific signalling data, the logical channel arranged for traffic data will be lc1, the logical channel arranged for signalling data will be lc2, etc. At step 510 a logical channel default value lcd is selected, i.e. the channel to which the data of a burst is interpreted to relate to if identification based on channel decoding fails. At step 515, a channel indicator n is set at zero, i.e. the identification is preferably started from the most likely alternative. After a burst is received (step 520), a first channel alternative will be examined by moving the indicator to the first alternative (step 525). The received burst is channel decoded by applying a channel decoding algorithm (step 530) associated with the selected logical channel, after which the success of the channel decoding is checked (step 535). If channel coding by means of the algorithm in question succeeded, the burst is interpreted to comprise information relating to the logical channel concerned (step 540). If channel decoding by means of the method in question failed, it is checked whether all possible channel alternatives have been used (step 545). If not, the process moves to step 525 where the next channel alternative will be examined. If all possible alternatives have been used, the burst is interpreted to comprise information relating to a selected logical channel determined as the default value (step 550). The identification of the next burst starts again with the most likely alternative, so if reception continues (step 555) the process moves to step 515 where the indicator is set at zero to indicate the first channel alternative to be checked.

The above described embodiment illustrates the basic idea of the invention in a simplified manner, i.e. without taking into account the logical channel information the burst possibly comprises. The block diagram in Figure 6 allows a situation to be examined in which the received burst comprises the information of the logical channel relating to the burst, the information being

also utilized. At step 610 the channels are arranged into a predetermined order in a manner described at step 505 in Figure 5. At step 615 the channel type used as the default value is determined and at step 618 the channel indicator is set to indicate the first channel alternative. The information relating to the logical channel, preferably a bit map, is checked (step 625) from the received burst (step 620). If the bit map shows that the burst relates to the logical channel determined as the default value, examination by means of channel decoding is not needed, but the burst can be directly interpreted to comprise information relating to the default value channel (step 660). If the information relating to the logical channel refers to another channel than the default value channel, the channel alternative arranged next in order will be examined (step 635) by moving the channel indicator. At step 640 the burst is channel decoded by applying a channel decoding algorithm (640) relating to the logical channel indicated by the channel indicator, after which the success of the channel decoding is checked (step 645). If the channel decoding succeeded, the burst is interpreted to comprise information relating to the logical channel concerned (step 650). If the channel decoding failed, it is checked whether all possible channel alternatives have been used (step 655). If there are alternatives that have not been used, the process continues to the next alternative by an increase of the channel indicator (to step 635). If all the alternatives have been used, the predetermined default channel is interpreted as the logical channel (step 660). The identification of the next burst starts again with the most likely alternative, so if reception continues (step 670) the process moves to step 618 where the indicator is set to indicate the first channel alternative to be checked. Figure 7 illustrates the method of the invention applied in the TETRA system to the identification of stealing in a received time slot. As described above, stealing is indicated in the TETRA system by means of a training sequence conveyed between the blocks of specific bursts. If the training sequence is TS1, the receiver interprets the whole time slot to comprise traffic channel TCH data. If the training sequence is TS2, the receiver interprets the time slot to be divided into two blocks, the first one of which is interpreted as stolen, i.e. to comprise signalling data of a channel STCH. The other block can comprise either traffic channel data (STCH+TCH) or signalling data (STCH+STCH). The receiver concludes which of the two situations is concerned on the basis of MAC (Medium Access Control) level headers, i.e. in a manner not dependent on the training

sequence.

Since only two channel alternatives are possible in the present case, Figure 7 shows the reception of one time slot in detail. Based on the reference indications used in the flow diagrams of Figures 5 and 6, Figure 7 shows an embodiment in which N=2; lc1=TCH, corresponding to the training sequence TS1; and lc2=STCH, corresponding to the training sequence TS2. A traffic channel TCH is the default channel. At step 710 a time slot is received from which a training sequence is identified (step 715). If the training sequence is TS1, which is mostly the case in radio communications, the time slot can be interpreted to comprise traffic data, i.e. the logical channel is lc1=TCH (step 750). If the training sequence is not identified as sequence number one, a channel decoding determined for a stolen block will be performed to the first block in the time slot, the channel decoding comprising convolution decoding and a cyclic redundancy calculation STCH-CRC (step 725). If the channel decoding succeeds (step 730), it is interpreted that stealing is concerned (step 755) and reception continues on the basis of normal system measures (step 760). But if the channel decoding fails, an attempt will be made to channel decode a second block by applying said channel decoding method determined for a stolen block (step 735). If the channel decoding succeeds (step 740), it can be concluded that stealing is concerned and, further, that the stealing concerns the whole time slot (STCH+STCH) (step 745). If the STCH channel decoding of the second block also fails, the training sequence is considered as misinterpreted. It can therefore be concluded that the time slot concerned is a traffic channel TCH, and the time slot can thus be forwarded identified as a traffic channel. This can be carried out for instance by changing TS1 as the training sequence of the time slot.

In a problem situation such as the one described above where due to demanding communications circumstances a training sequence TS1 is misinterpreted as a training sequence TS2, the above described method allows a TCH time slot to be saved, whereas otherwise it would be lost. A more accurate interpretation of the logical channel, particularly as regards traffic channels, significantly improves the operational features offered by the system. The advantages become particularly apparent in data transmission requiring low bit error ratios. In addition, improved quality of speech is obtained.

On the other hand, if the inventive method is applied to an STCH which is thereby changed to a traffic channel TCH, signalling is not essentially affected, because the change is made only after the channel decoding of the received STCH time slot has failed in both time slot blocks. Likewise, speech is not essentially affected either because the misinterpretation of the STCH channel as a TCH channel is substantially eliminated when speech decoding is applied; the speech CRC probably detects that the time slot in question is not a real TCH time slot.

It is apparent to a person skilled in the art that as technology advances, the basic idea of the invention can be implemented in various ways. The invention and its embodiments are therefore not restricted to the above described examples but they can vary within the scope of the claims.

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PCT/FI98/00921
The Swedish Patent Office
PCT International Application

CLAIMS

1. A method for identifying a logical channel in a radio frame part which may comprise information of one or more logical channels, channel decoding of the information being possible by means of channel decoding methods relating to the different logical channels, the frame part comprising a logical channel indicator, preferably a bit map, **characterized** in that the method comprises the steps of

reading the logical channel indicator from the information the received frame part comprises;

arranging selected channel decoding methods into the order in which they will be applied, the first channel decoding method selected being a channel decoding method relating to the logical channel indicated by said indicator;

channel decoding the information said frame part comprises in said selected order by applying the selected channel decoding methods until the channel decoding succeeds or all the selected channel decoding methods have been checked;

interpreting, in response to a channel decoding that succeeds when a selected channel decoding method is applied, said frame part to comprise information of the logical channel relating to the successful channel decoding method;

interpreting, in response to a channel decoding that fails when any one of the selected channel decoding methods is applied, said frame part to comprise information of a logical channel selected as the default value.

2. A method for ensuring that stealing is detected in a time slot or a time slot part, the time slot comprising a training sequence that indicates stealing, the method comprising

reading of said training sequence from the received time slot, **characterized** in that the method comprises the steps of

channel decoding, in response to stealing being indicated by said training sequence, a first time slot block by applying a channel decoding method relating to stealing;

channel decoding, in response to the channel decoding of said first block failing when the channel decoding method relating to stealing is applied, a second time slot block by applying a channel decoding method relating to stealing;

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interpreting, in response to the channel decoding of both the first and the second block failing when the channel decoding method relating to stealing is applied, the time slot to comprise traffic channel data.

3. A method according to claim 2, **characterized** by arranging, in response to the channel decoding of both the first and the second block failing when the channel decoding method relating to stealing is applied, a training sequence indicating a traffic channel as the training sequence.

4. A method according to claim 2 or 3, **characterized** by interpreting, in response to the channel decoding of the latter time slot block succeeding when the channel decoding method relating to stealing is applied, said time slot as a whole to comprise control channel data.

5. A receiver (420) functioning in a radio system, the receiver comprising a unit (46) performing channel decoding, the unit identifying one or more logical channels, and the unit comprising the methods relating to logical channels for channel decoding of the information that received radio frame parts comprise, the radio frame parts comprising a logical channel indicator, preferably a bit map, **characterized** in that said unit (46) is arranged to

read the logical channel indicator from the information a received frame part comprises;

arrange selected channel decoding methods into the order in which they will be applied, the first channel decoding method selected being a channel decoding method relating to a logical channel indicated by said indicator;

channel decode the information said frame part comprises in said selected order by applying the selected channel decoding methods until the channel decoding succeeds or all the selected channel decoding methods have been checked;

interpret, in response to a channel decoding that succeeds when a selected channel decoding method is applied, said frame part to comprise information of a logical channel relating to the successful channel decoding method;

interpret, in response to a channel decoding that fails when any one of the selected channel decoding methods is applied, said frame part to comprise information of a logical channel selected as the default value.

6. A receiver (420) functioning in a radio system, the receiver

comprising a unit (46) performing channel decoding, the unit being arranged to read from a received time slot a training sequence indicating stealing, **characterized** in that said unit (46) is arranged to

channel decode, in response to stealing being indicated by said training sequence, a first time slot block by applying a channel decoding method relating to stealing;

channel decode, in response to the channel decoding of said first block failing when the channel decoding method relating to stealing is applied, a second time slot block by applying the channel decoding method relating to stealing;

interpret, in response to the channel decoding of both the first and the second block failing when the channel decoding method relating to stealing is applied, the time slot to comprise traffic channel data.

7. A receiver according to claim 6, **characterized** in that said unit (46) is arranged to change, in response to the channel decoding of both the first and the second block failing when the channel decoding method relating to stealing is applied, a training sequence indicating a traffic channel as the training sequence.

8. A receiver according to claim 6 or 7, **characterized** in that said unit is arranged to interpret, in response to the channel decoding of the latter time slot block succeeding when the channel decoding method relating to stealing is applied, said time slot as a whole to comprise control channel data.

9. A receiver according to any one of claims 5 to 8, **characterized** in that the receiver is part of a base station of a mobile communications system.

10. A receiver according to any one of claims 5 to 8, **characterized** in that the receiver is part of a subscriber terminal of a mobile communications system.

11. A channel decoding unit (46) to be connected to a receiver (420) in a radio system, the unit being capable of identifying one or more logical channels and the unit comprising the methods relating to logical channels for the channel decoding of the information that received radio frame parts comprise, the radio frame parts comprising a logical channel indicator, preferably a bit map, characterized in that said unit (46) is arranged to

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read the logical channel indicator from the information a received frame part comprises;

arrange selected channel decoding methods into the order in which they will be applied, the first channel decoding method selected being a channel decoding method relating to a logical channel indicated by said indicator;

channel decode the information said frame part comprises in said selected order by applying the selected channel decoding methods until the channel decoding succeeds or all the selected channel decoding methods have been checked;

interpret, in response to a channel decoding that succeeds when a selected channel decoding method is applied, said frame part to comprise information of a logical channel relating to the successful channel decoding method;

interpret, in response to a channel decoding that fails when any one of the selected channel decoding methods is applied, said frame part to comprise information of a logical channel selected as the default value.

12. A channel decoding unit (46) to be connected to a receiver (420) in a radio system, the unit being arranged to read from a received time slot a training sequence indicating stealing, **characterized** in that the unit is arranged to

channel decode, in response to stealing being indicated by said training sequence, a first time slot block by applying a channel decoding method relating to stealing;

channel decode, in response to the channel decoding of said first block failing when the channel decoding method relating to stealing is applied, a second time slot block by applying the channel decoding method relating to stealing;

interpret, in response to the channel decoding relating to both the first and the second block failing when the channel decoding method relating to stealing is applied, the time slot to comprise traffic channel data.

13. A unit according to claim 12, **characterized** in that said unit is arranged to change, in response to the channel decoding of both the first and the second block failing when the channel decoding method relating to stealing is applied, a training sequence indicating a traffic channel as the training sequence.

14. A unit according to any one of claims 11 to 12, **characterized** in that the unit is arranged to interpret, in response to a channel decoding of the latter time slot block succeeding when the channel decoding method relating to stealing is applied, said time slot as a whole to comprise control channel data.

15. A unit according to any one of claims 11 to 14, **characterized** in that the unit is part of a base station of a mobile communications system.

16. A unit according to any one of claims 11 to 14, **characterized** in that the unit is part of a subscriber terminal of a mobile communications system.

CHANGED SHEET

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527 Rec'd PCT/PTO 25 MAY 2000

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CLEAN COPY OF AMENDED SHEET

Fig. 1

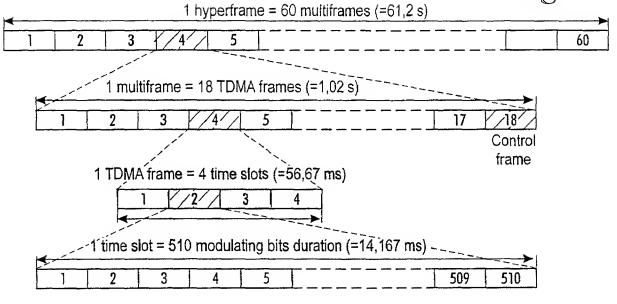


Fig. 2

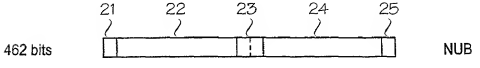


Fig. 3

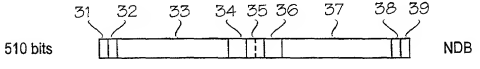


Fig. 4

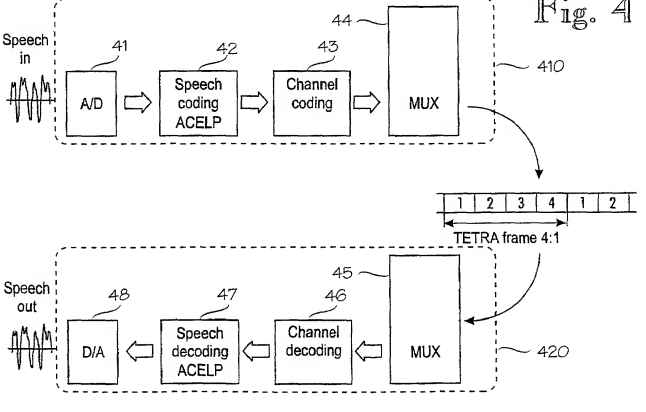


Fig. 5

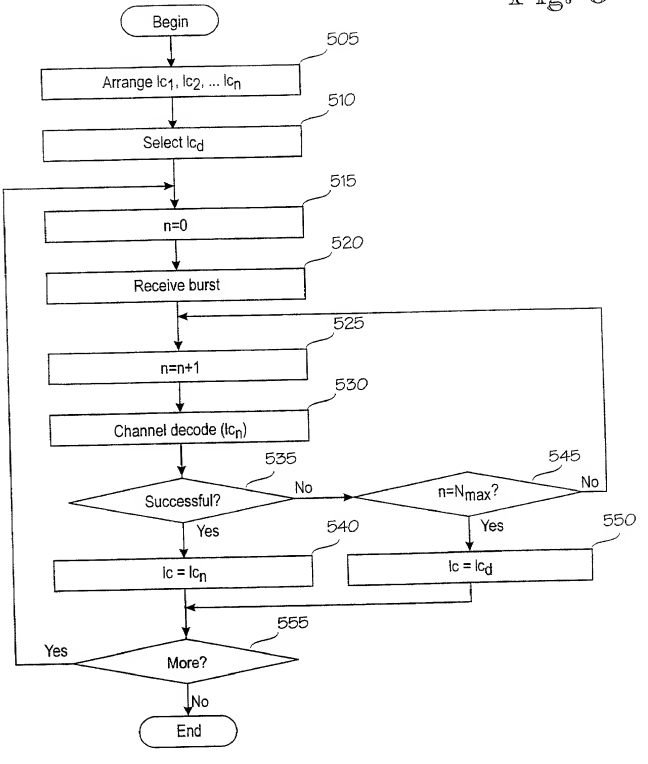

Begin
505
Arrange lc_1, lc_2, ... lc_n
510
Select lc_d
515
n=0
520
Receive burst
525
n=n+1
530
Channel decode (lc_n)
535
Successful?
No
Yes
545
$n=N_{max}$?
No
Yes
540
$lc = lc_n$
550
$lc = lc_d$
555
More?
Yes
No
End

Fig. 6

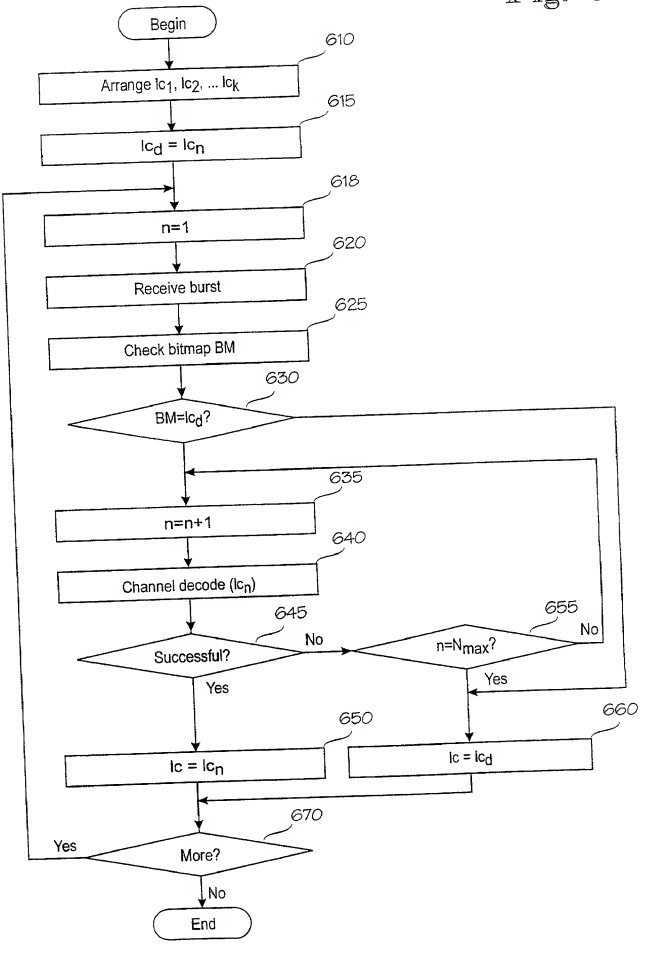
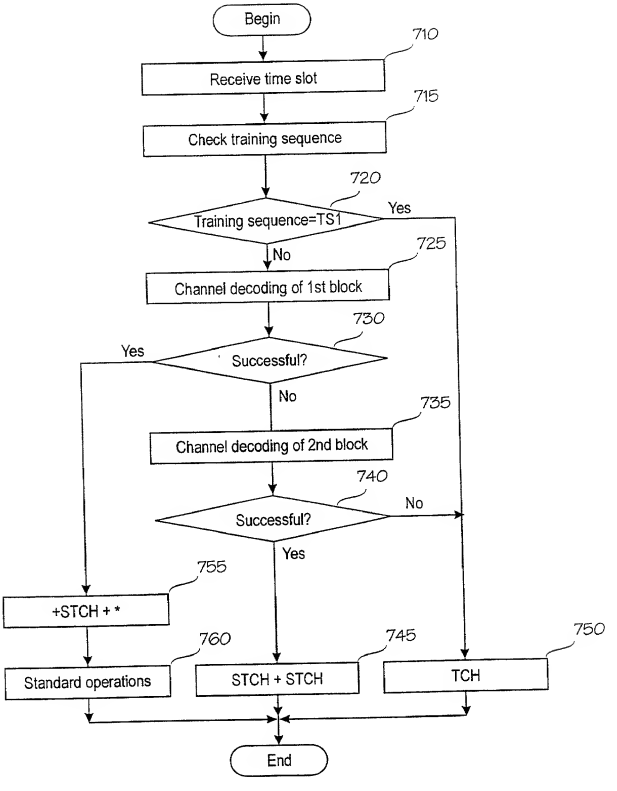

Begin
610
Arrange lc_1, lc_2, ... lc_k
615
$lc_d = lc_n$
618
n=1
620
Receive burst
625
Check bitmap BM
630
BM=lc_d?
635
n=n+1
640
Channel decode (lc_n)
645
Successful?
No
655
$n=N_{max}$?
No
Yes
Yes
650
$lc = lc_n$
660
$lc = lc_d$
670
More?
Yes
No
End

Fig. 7


Begin
710
Receive time slot
715
Check training sequence
720
Training sequence=TS1
Yes
No
725
Channel decoding of 1st block
730
Yes
Successful?
No
735
Channel decoding of 2nd block
740
Successful?
No
Yes
755
+STCH + *
760
Standard operations
745
STCH + STCH
750
TCH
End

FOR UTILITY/DESIGN
CIP/PCT NATIONAL/PLANT
ORIGINAL/SUBSTITUTE/SUPPLEMENTAL
DECLARATIONS

RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PM&S
FORM

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the INVENTION ENTITLED

Method and equipment for identifying a logical channel

the specification of which (CHECK applicable BOX(ES))

X -> [ ] is attached hereto.

BOX(ES) -> [ ] was filed on _____ as U.S. Application No. 0 _____

-> [X] was filed as PCT International Application No. PCT/FI98/00921 on 24 November 1998

-> -> and (if U.S. or PCT application amended) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date (1) before that of the application on which priority is claimed, or (2) if no priority claimed, before the filing date of this application:

PRIOR FOREIGN APPLICATION(S) Number	Country	Day/MONTH/Year Filed	Date first Laid-open or Published	Date Patented or Granted	Priority Claimed Yes	No
974381	FI	1 Dec 1997			X	

I hereby claim domestic priority benefit under 35 U.S.C. 119/120/365 of the indicated United States applications listed below and PCT international applications listed above or below and, if this is a continuation-in-part (CIP) application, insofar as the subject matter disclosed and claimed in this application is in addition to that disclosed in such prior applications, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of each such prior application and the national or PCT international filing date of this application:

PRIOR U.S. PROVISIONAL, NONPROVISIONAL AND/OR PCT APPLICATION(S) Application No. (series code/serial no.)	Day/MONTH/Year Filed	Status pending, abandoned, patented	Priority Claimed Yes	No

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

And I hereby appoint Pillsbury Madison & Sutro LLP, Intellectual Property Group, 1100 New York Avenue, N.W., Ninth Floor, East Tower, Washington, D.C. 20005-3918, telephone number (202) 861-3000 (to whom all communications are to be directed), and the below-named persons (of the same address) individually and collectively my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent, and I hereby authorize them to delete names/numbers below of persons no longer with their firm and to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct the above Firm and/or a below attorney in writing to the contrary.

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G. Lloyd Knight	17698	Glenn J. Perry	28458	Timothy J. Klima	34852
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Kevin E. Joyce	20508	Paul E. White, Jr.	32011	Paul F. McQuade	31542
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				Adam R. Hess	41835
				Roger R. Wise	31204
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				Anita M. Kirkpatrick	32617
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				W. Patrick Bengtsson	32456
				Jack S. Barufka	37087

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Inventor's Name (typed) _____ | | _____
First | Middle Initial | Family Name | Country of Citizenship

Residence (City) _____ (State/Foreign Country) _____

Post Office Address (Include Zip Code) _____

(FOR ADDITIONAL INVENTORS, check box [ ] and attach sheet (PAT-116.2) for same information for each re signature, name, date, citizenship, residence and address.)

(a) ...Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the [Patent and Trademark] Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability...(b) information is material to patentability when it is not cumulative and (1) It also establishes by itself, or in combination with other information, a prima facie case of unpatentability of a claim or (2) refutes, or is inconsistent with, a position the applicant takes in: (i) Opposing an argument of unpatentability relied on by the Office, or (ii) Asserting an argument of patentability.

PATENT LAWS 35 U.S.C.

§102. Conditions for patentability; novelty and loss of right to patent

A person shall be entitled to a patent unless--

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months* before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application fo patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

§103. Condition for patentability; non-obvious subject matter

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made....

(c) Subject matter developed by another person, which qualified as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

* Six months for Design Applications (35 U.S.C. 172).